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ABSTRACT

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TECH MEMO

LATENCY AND TEST ANXIETY

Sigmund Tobias, John J. Hedl, Jr., & Nelson J. Towle

Tech Memo No. 56
August 1, 1972
Tallahassee, Florida

Project NR 154-280
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ABSTRACT

This study sought to test the interpretation that high test anxiety subjects performed more poorly on difficult material because they divided their attention between personally relevant and task relevant concerns to a greater degree than low anxiety individuals. It was reasoned that such division of attention ought to require more time for HA students on difficult items and hence should result in higher response latency. A mathematical aptitude test containing both easy and difficult items was administered to 80 subjects. Analysis of variance indicated that HA students performed more poorly on the difficult sections than LA individuals. However, the latency data failed to confirm the hypotheses.

Latency and Test Anxiety

Sigmund Tobias[1], John J. Hedl, Jr.[2], Nelson J. Towle

Florida State University

The concept of test anxiety was advanced by Mandler and Sarason (1952) as a measure of the degree to which an individual was anxiety prone in the testing situation. It was reasoned that items which dealt directly with students' reaction to testing situations would be more closely related to performance in such settings than would scores on general anxiety scales such as the TMAS (Taylor, 1953) which pertain to an individuals feelings about a whole variety of day to day events. Subsequent research reviewed recently by I. G. Sarason (in press) has confirmed this hypothesis. Typical of these investigations is one by Sarason and Palola (1960) in which interactions between test anxiety and a number of other variables were obtained in three different investigations; but when the data were reanalyzed with the manifest anxiety scale as a classifying instrument, none of the interactions achieved significance.

A substantial body of research, reviewed by Sarason (in press), and by Wine (1971) has indicated that individuals high in test anxiety do indeed perform more poorly on tasks than do students lower in test anxiety. This disparity in performance between high and low test anxious subjects is especially evident on difficult experimental tasks, under conditions of intense evaluative stress. Sarason and Palola (1960) found

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interactions between test anxiety and task difficulty indicating that the performance of low anxious (LA) students was superior on difficult material to that of high anxious (HA) subjects. However, on easy material performance differences were either nonsignificant or favored HA students.

Wine (1971) has suggested that the mechanism accounting for the difference in performance between high and low anxious individuals may be a function of the way their attention is directed. High anxious persons, Wine suggests, divide their attention between task-relevant and self-relevant concerns. The latter include feelings of negative self-regard, self-depreciation, and concern with physical symptomatology related to autonomic arousal. On the other hand, low test-anxious persons devote a greater percentage of their attention to task-relevant stimuli and less to personally relevant concerns. Thus, the observed discrepancies in test performance can be explained in terms of the amount of attention the person devotes to problems pertaining to the task situation.

If the high test anxious individual does divide his attention between personal and task relevant concerns, it can be deduced that the latency of his responses to test items should be significantly greater than that of the low test-anxious person. The alteration of attention between task cues and internal cues should consume more time than the lesser degree of alteration hypothesized to occur for low test anxious students. It was the purpose of the present study to test this hypothesis. Furthermore, since Sarason and Palola (1960) had shown an interaction between test anxiety and task difficulty on performance, it was the purpose of the present investigation to replicate that findings, and examine a

similar interaction on response latency. Specifically, it was reasoned that LA individuals would respond more rapidly to difficult items than HA individuals for whom personal concerns should have intervened with their attention to the task; no differences in latency on the easy material were expected.

One assumption of studies in which anxiety is a variable assumed to be operative on the basis of a test score is that the anxiety reflected by the test is in fact engaged in the research situation. It has been pointed out elsewhere (Tobias, 1970) that it is quite an intuitive leap to assume that students manifest the same degree of concern in the research task that they do during tests in their course work, and that this assumption should be verified by evidence. This question is similar to the concern which prompted Spielberger (1966) to differentiate between state and trait anxiety. Trait anxiety refers to the relatively stable differences in anxiety proneness, is consistent over time, and similar to other general anxiety measures. State anxiety, on the other hand is viewed as transitory, fluctuating over time, and responsive to changes in the situation in which the individual finds himself. These conceptualizations have been operationally defined in the State, Trait Anxiety Inventory (Spielberger, Gorsuch, and Lushene, 1970). A brief five item version of the State Anxiety questionnaire has been frequently used in investigations on the degree to which anxiety is present during learning and evaluative tasks (Spielberger, O'Neil, and Hansen, 1972). In these investigations it has been found, as predicted by state and trait anxiety theory, that high trait anxiety individuals, have significantly higher State Anxiety scores than low trait anxiety individuals. It had not, however, been determined whether individuals

high in test anxiety would also have higher state anxiety during testing than low test anxiety students. Thus, state anxiety was assessed in the present investigation for two reasons: 1) to determine whether the anxiety was in fact engaged during the instructional situation, and 2) to test whether individuals scoring high on test anxiety had higher State Anxiety scores during an evaluative test situation than low anxiety students.

Method

This study is part of a larger investigation seeking to determine the effects of different sequences in which test items were ordered, and their interactions with other variables. The present report is based on two groups used in the larger study, a group in which test items were ordered from easy to difficult, and a group in which test items appeared in a random sequence. Preliminary analysis (Towle and Merrill, 1972) had shown that there were no performance effects attributable to differences in sequence between these two groups.

The basic design consisted of a two by two analysis of variance with repeated measures on the second factor. The first level was defined as high and low anxiety, and the second level consisted of a student's performance and latency on the 16 easiest and the 16 most difficult test items.

Subjects

A total of 90 students served as the original subject pool for this study. In order to achieve equal cell sizes, 8 students were randomly deleted in addition to the 4 students whose test anxiety scores fell at the median. Participation in this investigation was obligatory on students in order to successfully complete the introductory psychology course requirements.

Materials

The test on which the performance and latency dependent measures were accumulated was composed of 48 items selected from the quantitative section of the Florida Statewide Twelfth Grade testing program. It was identified as a mathematic aptitude test in the instructions distributed to students.

Item difficulty indices, supplied by the Board of University examiners, administrators of the Florida Statewide Twelfth Grade testing program, were based on a random sample of 400 students from the entire statewide 12th grade class membership for each of two years. Items were chosen to make up the Mathematics Aptitude Test on the basis of a wide range of difficulty indices. Each test item on the MAT consisted of a stated problem to which 5 possible multiple choice responses were supplied. For the purposes of the present study, students' performance on the 16 easiest and 16 hardest items were summed to yield two performance scores. The latencies for the easiest and hardest items were similarly summed.

The 37-item Test Anxiety Scale (TAS; Sarason, In Press) was administered, together with a number of other research scales not used in the present study, to students prior to the beginning of the experimental session.

Procedure

Students were randomly assigned to experimental conditions on the basis of the order of their arrival for each experimental session, and tested in groups of 10 to 16 students.

The experimental session consisted of two stages: 1) The pretesting stage during which students responded to the Test Anxiety Scale as well as a number of other paper and pencil research instruments. 2) Testing stage, in which the students were given instruction on the operation of the computer

terminal and then signed on to the computer system for practice. After a short practice session, the five-item version of the STAI A-State scale (Spielberger et al, 1970) was administered on the terminals followed by the first 24 items of the Mathematics Aptitude Test. A second administration of the five-item A-State scale was followed by the last 24 items of the Mathematics Aptitude Test. The A-State scale was readministered at the conclusion of the MAT. The total experimental session lasted for about two hours.

The study was conducted on an IBM 1500 Instructional System. Students worked on a cathode ray tube terminal connected to a computer. Ther terminals were housed in individual carrells insuring a fair degree of privacy for each student. The computer system automatically recorded latency and performance on each item.

Results

The basic dependent measures in this investigation were the number right on the easiest third, and the most difficult third of the items, and the latencies for the same items. A median split of the TAS data yielded a high and low anxiety group (Median = 16). The performance data were then subjected to a 2 x 2 ANOVA with repeated measures on the second factor. The results of that analysis are reported in Table 1.

Table 1

Results of ANOVA for Performance and Latency Data

Source	Performance			Latencies	
	df	ms	E	ms	F
Total	159	18.94		39.9	
Between	79	15.76		32.3	
Anxiety (A)	1	18.91	1.20	18.1	<1
Error	78	15.72		32.5	
Within-	80	22.08		47.4	105.5**
Difficulty (D)	1	1351.41	271.19**	2153.7	
AXD	1	26.41	5.30*	48.5	2.38
Error	78	4.98		20.4	

*$p < .05$
**$p < .001$

This ANOVA indicated that as expected there was a strong main effect for difficulty which in the present context only concerned the fact that the last 16 items were significantly more difficult than the first. Additionally, the predicted interaction between difficulty and test anxiety on performance was obtained ($F = 5.30$, $p < .05$), and is depicted in Figure 1. Analysis of the means, reported in table 2, (and inspection of Figure 1) indicated that as expected, the high anxiety group's performance

Table 2

Means and State Anxieties of Latency and Performance Data by Difficulty and Anxiety

	Low Anxiety				High Anxiety			
	Easy		Difficult		Easy		Difficult	
	M	SD	M	SD	M	SD	M	SD
Latency[1]	11.1	2.6	19.5	7.3	11.5	2.4	17.7	6.3
Performance	14.0	2.4	9.0	2.4	14.1	1.7	7.4	1.7

[1]In minutes

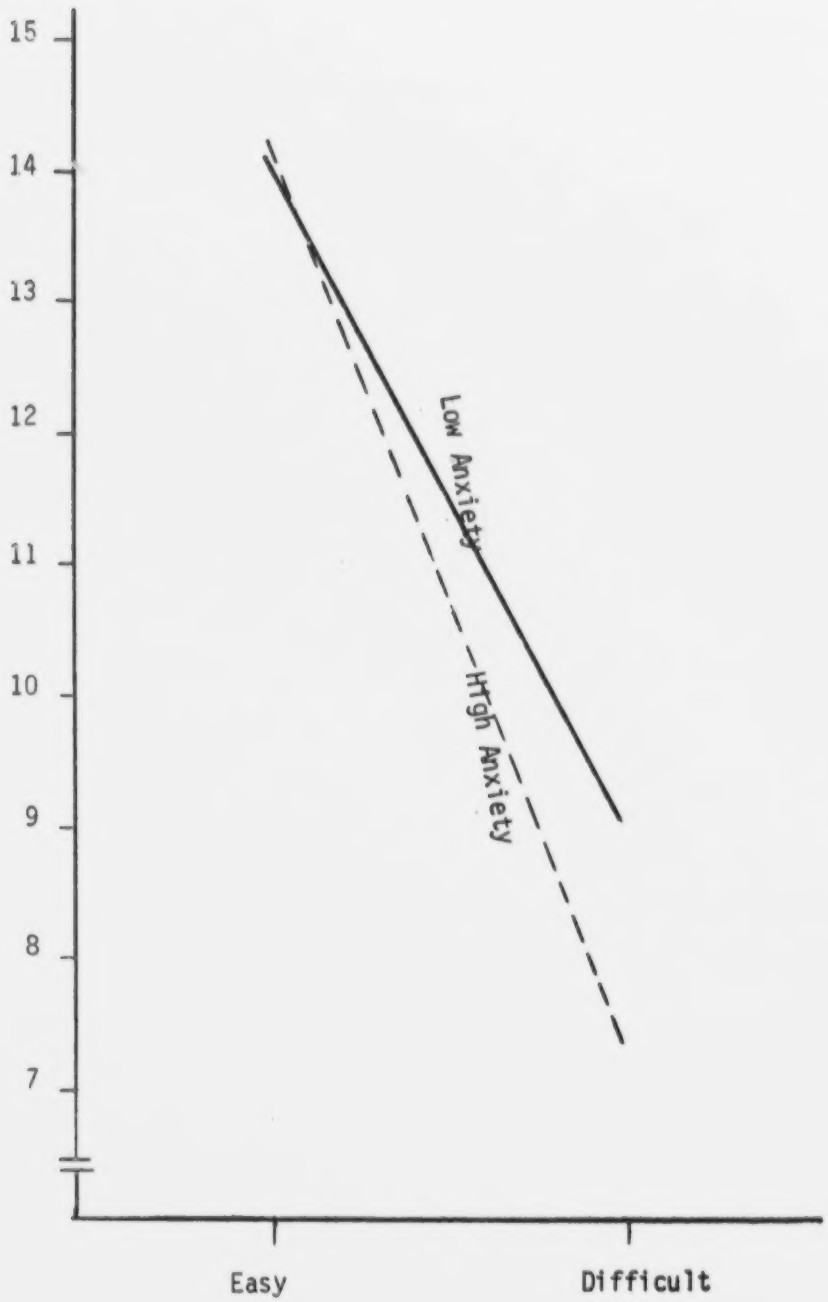

Figure 1.--Plot of Performance Data for Easy and Difficult Scores.

on the difficult items was impaired compared to the low anxiety students. The latency data was subjected, to a similar 2 x 2 ANOVA. The results of that analysis are also reported in the last two columns of Table 1. Contrary to prediction, the expected anxiety by difficulty interaction did not attain significance on latency. Furthermore, the latency means, reported in Table 2, indicate that high anxiety individuals had lower latencies for the difficult material than the low anxiety students, a finding contrary to present expectations.

The present analysis used groups who took the test in the easy to hard sequence, and in a random order. A 2 x 2 x 2 ANOVA of the data in which sequence was the second factor, indicated that there were no significant sequence main effects or interactions, confirming the fact that pooling the two sequence groups had no effect on the data

Table 3 gives the mean A-State scores for all groups.

Table 3

A-State Anxiety by Condition

	High Anxiety		Low Anxiety		Total
	M	SD	M	SD	
Pre Task	10.1	3.5	7.8	2.7	9.0
Mid-Task	9.4	3.3	7.5	2.7	8.4
Part Task	9.1	3.4	7.6	3.3	8.4

*Net used in present analysis

A 2 x 2 x 2 analysis of variance was computed with the two test anxiety groups defining the first level, the easy-to-hard and random sequence groups the second level, and the third level consisting of a repeated

measure defined by the A-State administered pretest and at the end of the difficult items. The only significant effect revealed by this analysis was a F of 11.43 for anxiety, indicating clear differences between the high and low test anxiety groups on the A-States. None of the other main effects or interactions were significant.

Discussion

The results of this study replicated earlier findings regarding an interaction between performance and test anxiety. That is, there was little difference between high and low anxiety subjects on the easy material, but the low anxiety subjects' performance was superior on the difficult material. The results also confirmed the hypothesis that high test anxiety students would have higher state anxiety during the task than LA students.

The data failed to confirm the main hypothesis of this investigation, namely, that the HA students would have a higher response latency on difficult materials than low (LA) subjects. This prediction was generated from Wine's formulation that HA individuals spent more time with personal relevant concerns than did the LA individuals.

The failure to confirm the latency hypotheses could be attributed to the conditions of this experiment, or to the possibility that the alteration of attention hypothesis works differently than first assumed. In terms of the present procedures, the experimental task consisted of a multiple choice math aptitude test. In addition to being able to make a wild guess, students were also able to make no responses to particular test items. It was, therefore, possible for HA subjects to avoid the anxiety arousing difficult items easily. In terms of the attentional formulation, as students became involved with personal preoccupations of a

self-deprecating nature, they were able to avoid these relatively rapidly by guessing at an answer, or making no answer to a particular item. The fact that the HA students have faster response latencies to the difficult material, coupled with poor performance on these items, suggests that these groups may well have coped with the situation by the kind of avoidance behavior suggested above.

If the failure to confirm the latency hypothesis was due to avoidance behavior, the implications for further research are quite clear-cut. An experimental situation in which students are unable to guess, enter a blank response, or omit an item, would require the student to continue to process both task and personally relevant concerns without being able to avoid either. In such a situation, then, lower response latencies for HA subjects on difficult materials should indeed be obtained. A further suggestion for future research would be to employ both neutral and ego-involving conditions so that in addition to being forced to attend to the task due to the design of the experimental situation, individuals would then, also experience psychological pressure which would make avoidance doubly difficult. Other research on test anxiety has indicated that HA subjects typically perform more poorly in an ego involving situation employing difficult material (Wine, 1971; Sarason, 1972) than under neutral conditions.

The suggestion for further research discussed above has assumed that Wine's alteration of attention formulation implies that HA subjects take more time to perform on cognitive tasks since they have to divide their attention between task and personally relevant concerns to a greater degree than LA individuals. It seems quite possible, however, for the alternation of attention to work in different ways. Instead of taking more time to

solve problems by virtue of attending to internal and task considerations, HA subjects may take the same amount of time that LA subjects do but use it less effectively. That is, rather than take the time to sort out both task relevant and personally relevant concerns, and attempt a problem solution, which would imply longer response latencies, these individuals may take the same amount of time and perform more poorly because they spend less total time on task relevant concerns than do the LA subjects. If this reasoning is correct, no differences in response latency would be expected between HA and LA individuals. The results of this investigation have, thus, suggested two possible ways in which the alteration of attention affects the performance of HA subjects. One alternative is that HA subjects take more time to solve problems since they have to divide their attention between internal and task relevant questions. This greater expenditure of time, however, does not result in more effective performance since there is assumed to be such great alteration between attempting to solve the task and personal preoccupation. A second way in which the alternation of attention mechanism could work is that HA subjects do not take more time to solve problems than LA subjects but instead take similar amounts of time but use it less efficiently since less total time is spent on task relevant concerns.

These alternative possibilities can best be evaluated in a series of experiments. First, the suggestions made above regarding use of an experimental task in which students would be unable to engage in avoidance behavior would clarify the question whether HA subjects in fact do take more time, on difficult material. Positive findings in such investigations would tend to strengthen the possibility that the alteration of attention

suggested does take more time. Further research may then explore the kind of performance differences to be expected in tasks in which individuals have fixed amounts of time available for each problem compared to the performance under self-paced conditions. If a number of different externally paced conditions are employed, and compared to self-paced groups, the exact mechanism by which the alterational hypothesis could work would be substantially clarified.

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